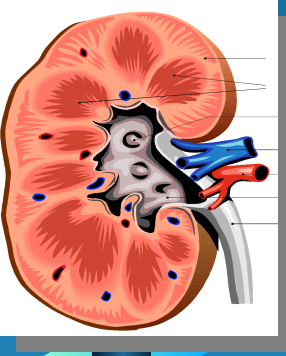

WRAMC
Walter Reed Army Medical Center
NEPHROLOGY SERVICE

Introduction to the Percutaneous Renal Biopsy in Patients with Medical Diseases of the Kidney

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An Interdisciplinary Conference of Nephrology,

Radiology, Organ Transplantation,

Pediatrics and Pathology

ARMY MEDICINE
CARING BEYOND THE CALL OF DUTY

Purpose of today's talk

- The approach to high risk patients for patients needing renal biopsy has been changing rapidly, as new techniques develop.
- These changes have led to some differences of opinion between services.
- Our goal today is to learn from each other and lay groundwork for a consensus approach to the management of these patients.

Objectives

- Understand the essential history of the renal biopsy
- Know what constitutes high risk for patients undergoing renal biopsy.
- Know the difference between absolute and relative contraindications to renal biopsy.

Objectives (Cont'd)

- Know the current and emerging techniques for this procedure
- Understand what constitutes adequate tissue for diagnosis
- Know how to diagnose and manage complications of this procedure
- Discuss an institution specific approach to these patients

Outline

- Brief History of the Renal Biopsy in Medical Diseases of the Kidney
- Brief overview of current approach to low risk patients
- Approaches to high risk patients (and who *IS* high risk?):
  - medical
  - technical

Outline (Cont'd)

- Comparison of adequacy, risk and complexity (i.e., cost) for the various approaches
- Diagnosis and Management of Complications
- Will focus an area's discussion on prospective trials if they exist, brief discussion of retrospective trials and case series/reports.

Historical Background

- Percutaneous kidney biopsy (of palpable tumors) first performed by Ball in 1934 in London (1)
- Iversen and Brun in Denmark, 1951, first to perform needle kidney biopsy for medical disease (Ibid)

1) Renal Biopsy: An Historical Perspective, Conrad R. Pirani, from Renal Biopsy Interpretation, Silva, D'Agati, Nadasdy eds, Churchill Livingstone, New York, c 1996.

Historical Background (Cont'd)

- Introduced in 1953 to US by Parrish and Howe of the Washington, DC VA Hospital (Ibid).
- At Georgetown, Dr. George Schreiner and colleagues established one of the first clinico-pathology working groups (Ibid).

Historical Background (Cont'd)

- In Chicago in 1954, Kark and Muehrcke used a Franklin modified Vim-Silverman needle and positioned the patient prone (rather than standing), using the "blind approach" (and later IVP) localize the kidneys and procure renal tissue (Ibid). This technique would remain prevalent for more than 40 years!

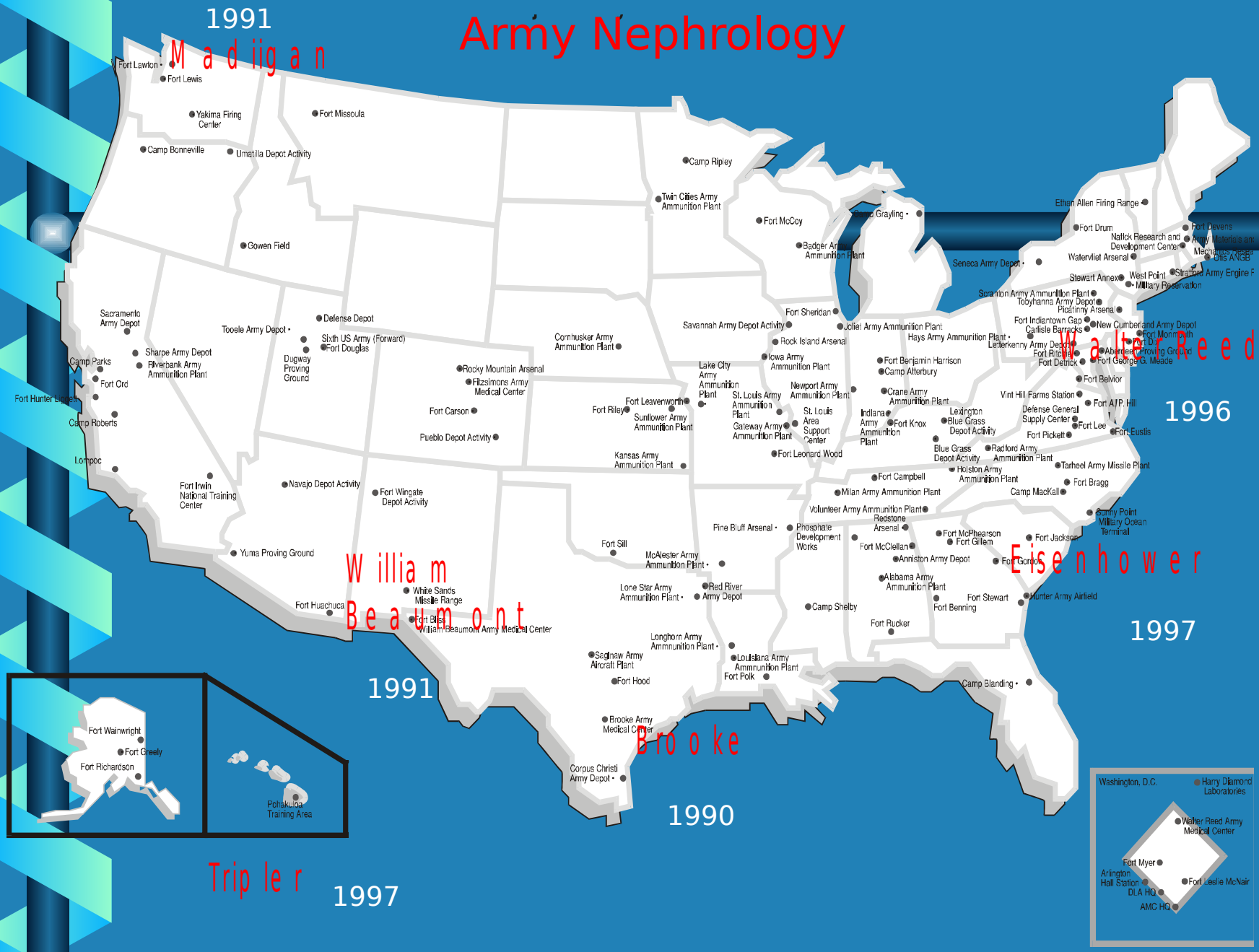
Historical Background (Cont'd)

- Various imaging modalities, such as IVP, fluoroscopy, renal scintigraphy, and ultrasound were also used to localize the kidneys.
- Of these, ultrasound was found the localize the lower pole (the lowest risk approach and highest yield for glomeruli) the best. Also not affected by renal failure. Systematically compared by Bolton et al (1).

Historical Background (Cont'd)

- Two other key events developed later:
  - Real-time ultrasound guidance was used to visualize a Tru-Cut needle as it entered the kidney (1) at Rush-Presbyterian in Chicago by Birnholz et al.
  - Adopting techniques used for liver biopsy, a spring-loaded biopsy gun (18g) was used to obtain renal tissue at Wilford Hall Medical Center in San Antonio (2). Many other subsequent reports were published (3).

Army Nephrology

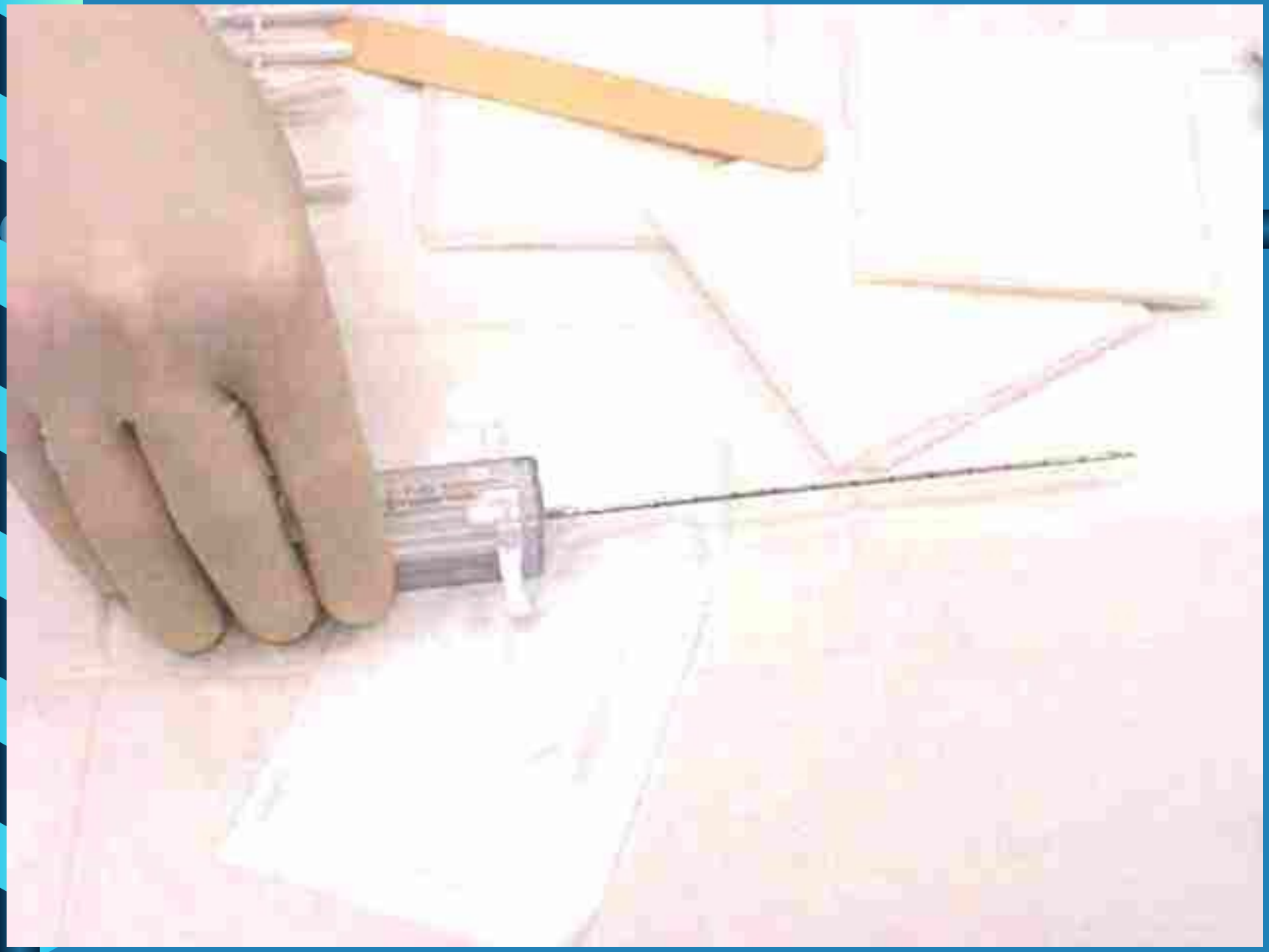


Historical Background (Cont'd)

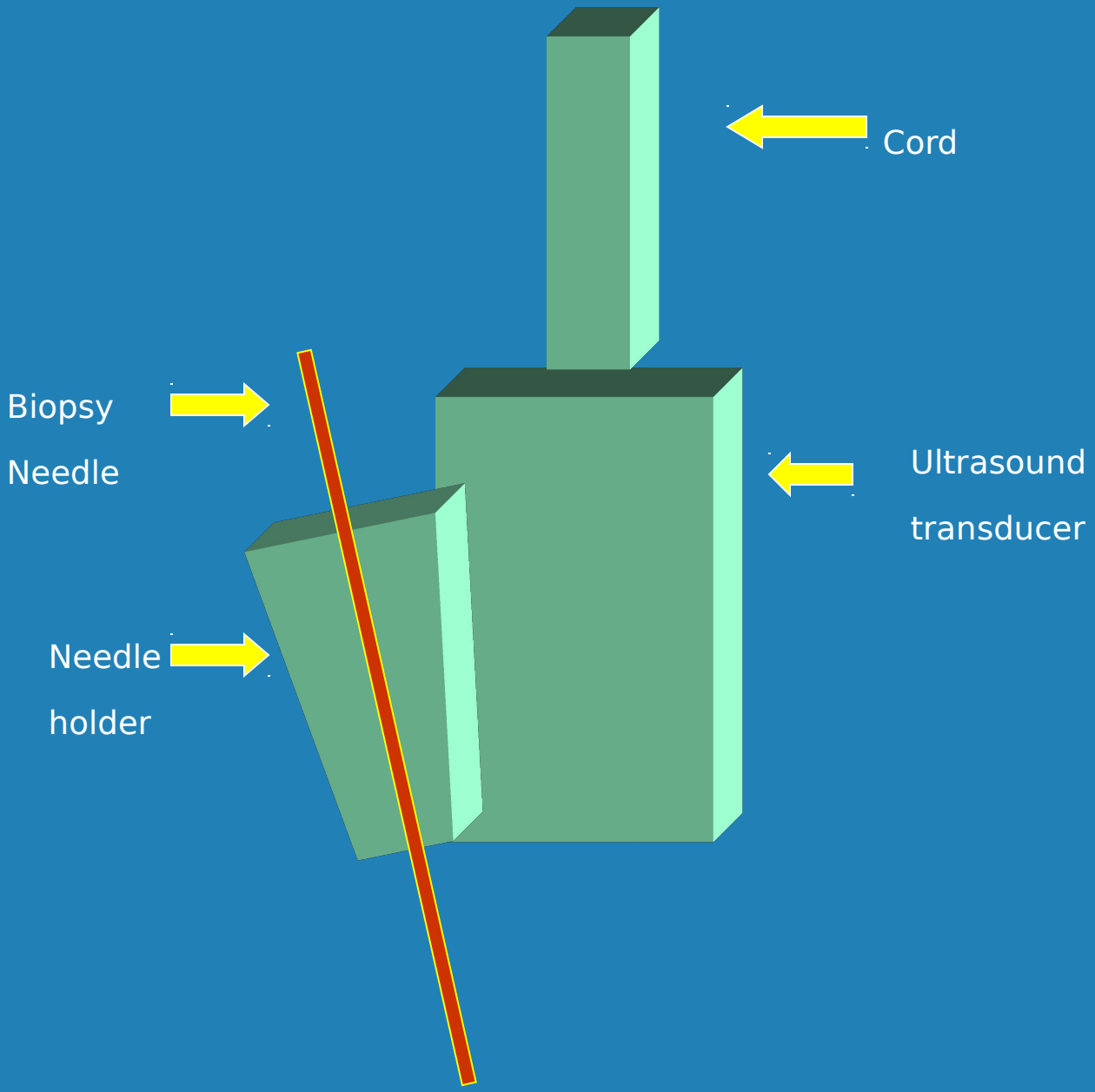
- Although initially more labor-intensive, the time the needle spent in the kidney was shortened.
- Also of importance--especially for non-surgeons-- this technique required less dexterity to obtain good samples.

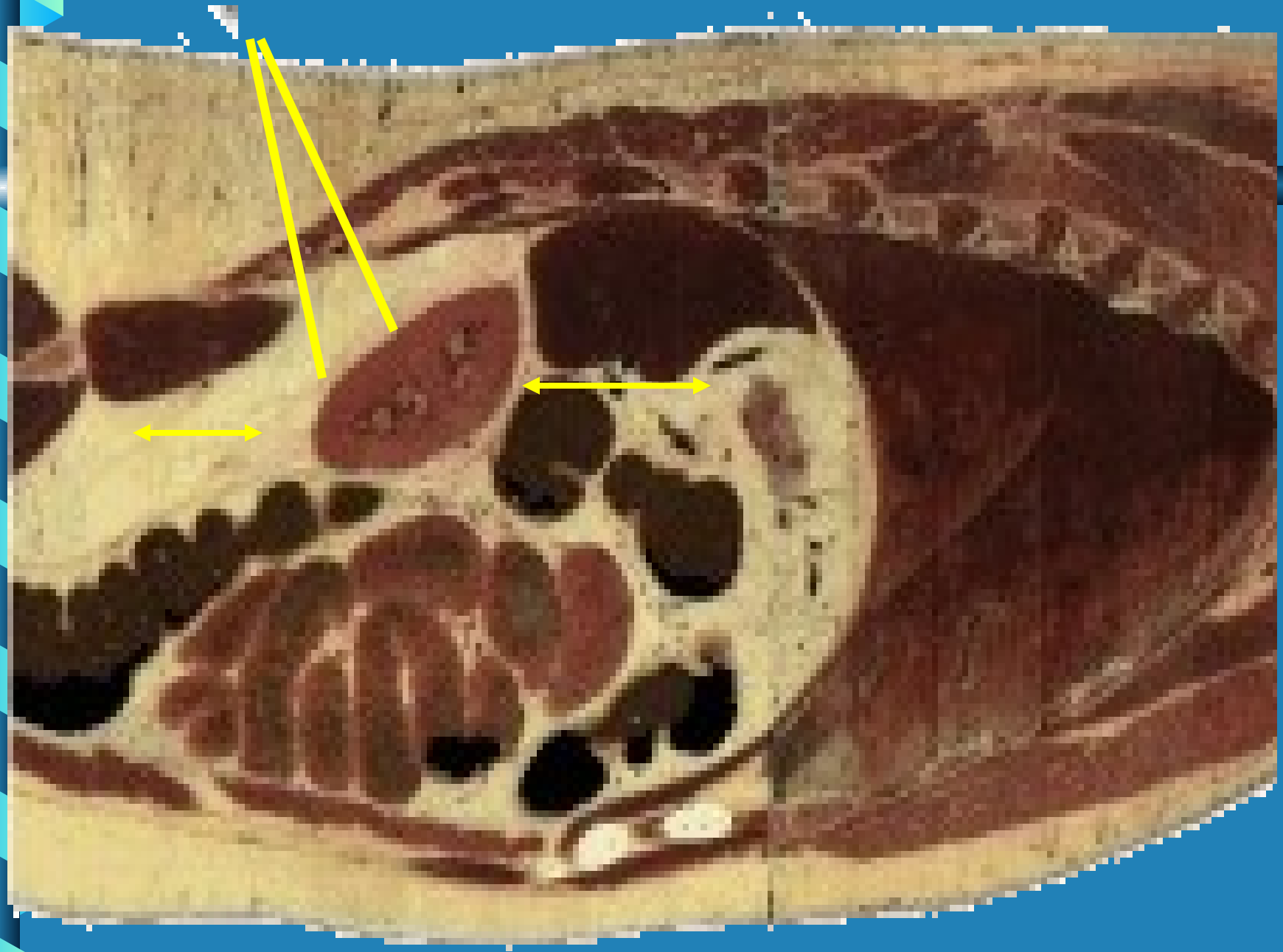
Current Practice

- Despite the lack of well designed clinical trials with supporting evidence, these techniques have proliferated and become the de facto standard for kidney biopsies in the US (although exact practice patterns are difficult to quantitate because they are not tracked nationally.)



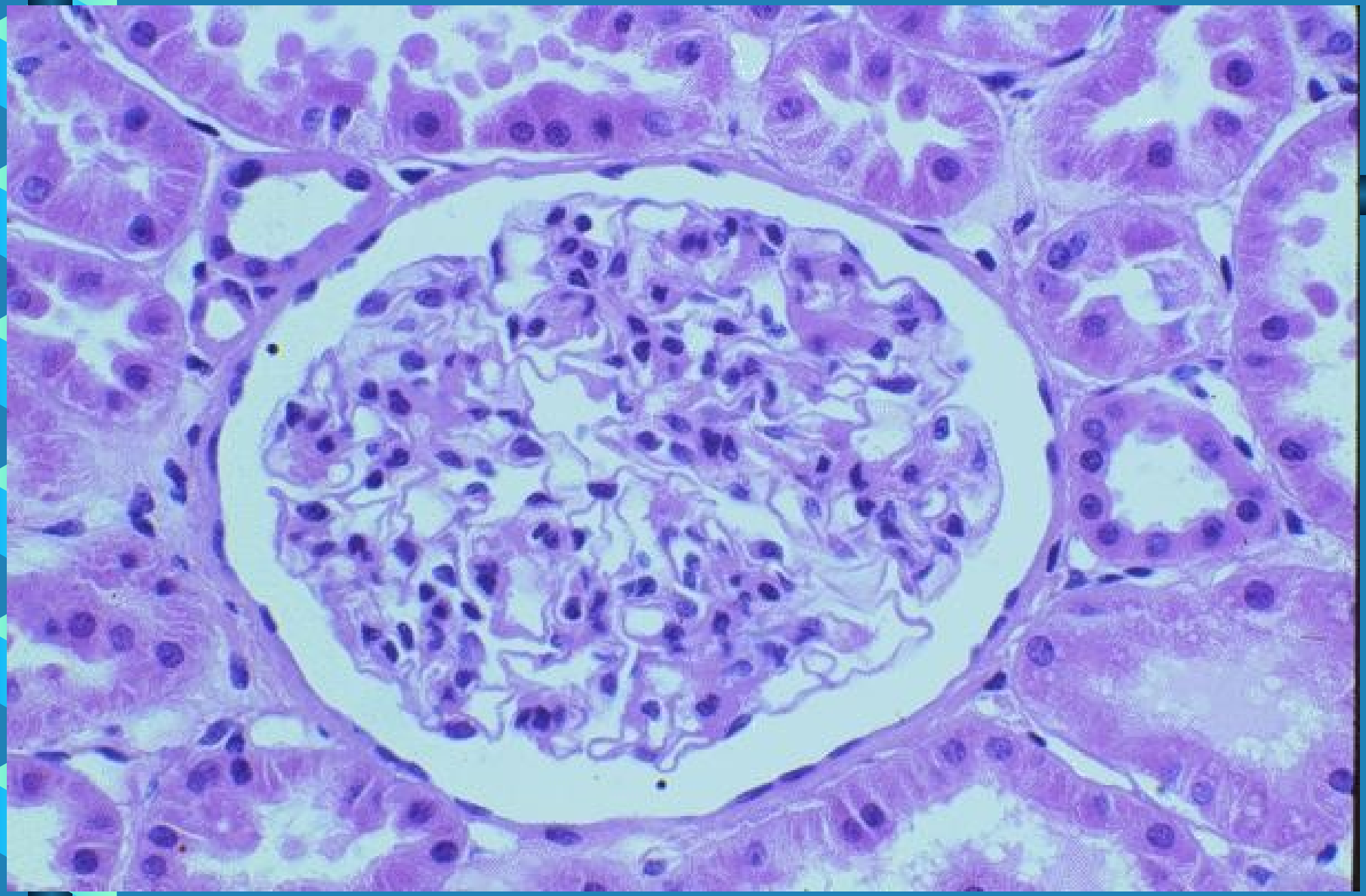
Transducer

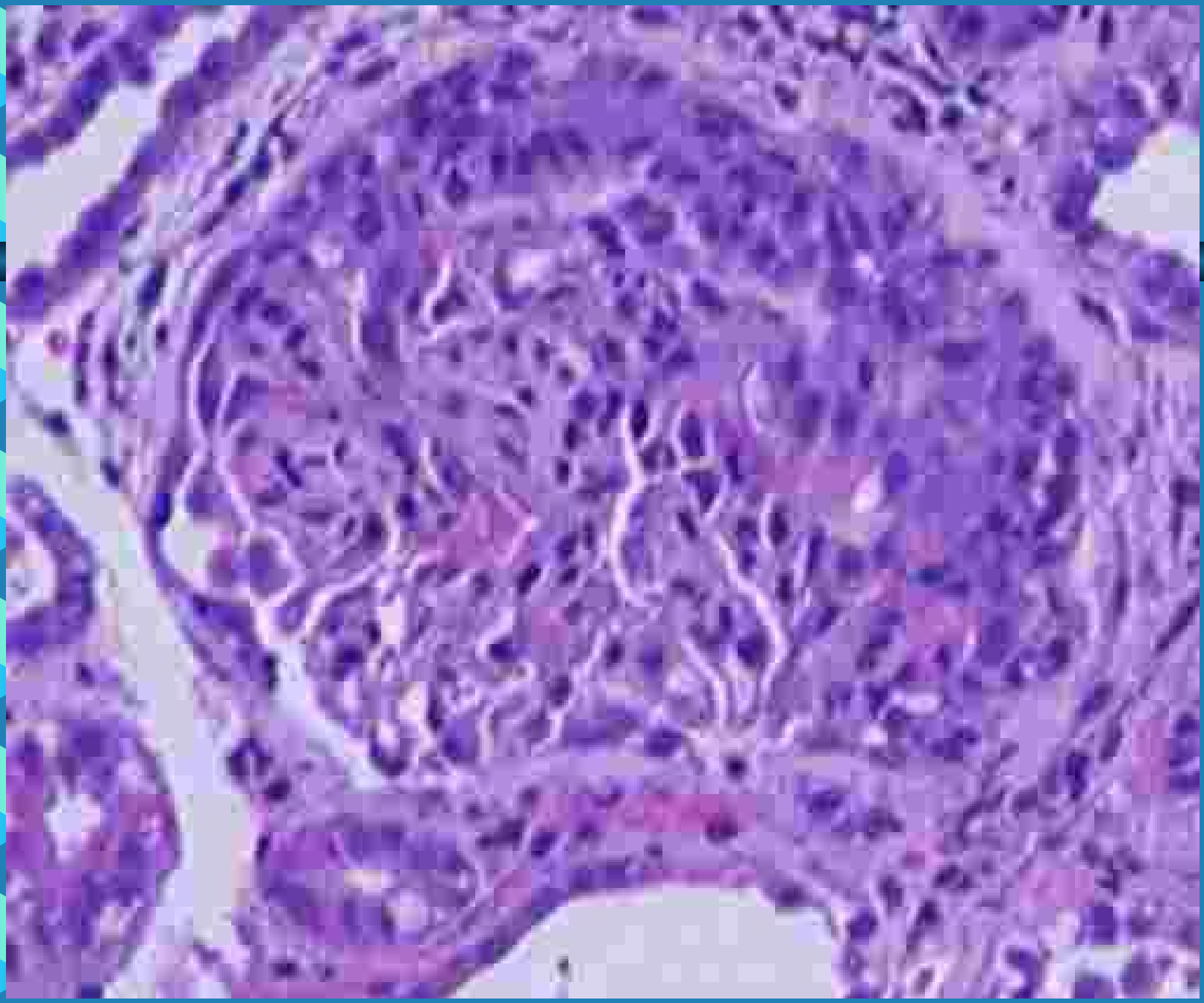

Cord
Biopsy
Needle
Ultrasound
transducer
Needle
holder



Movie of ultrasound guided renal biopsy

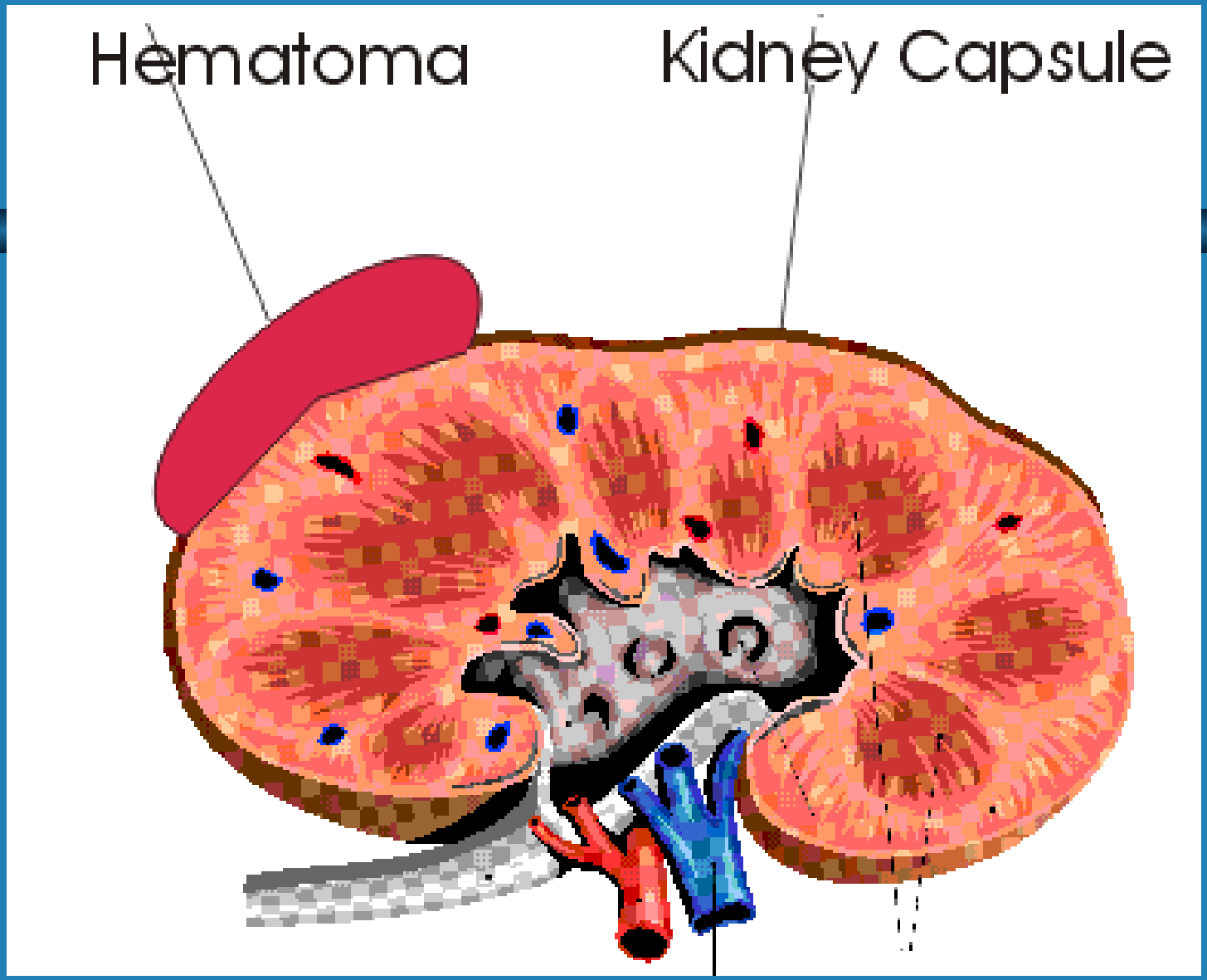
- Movie

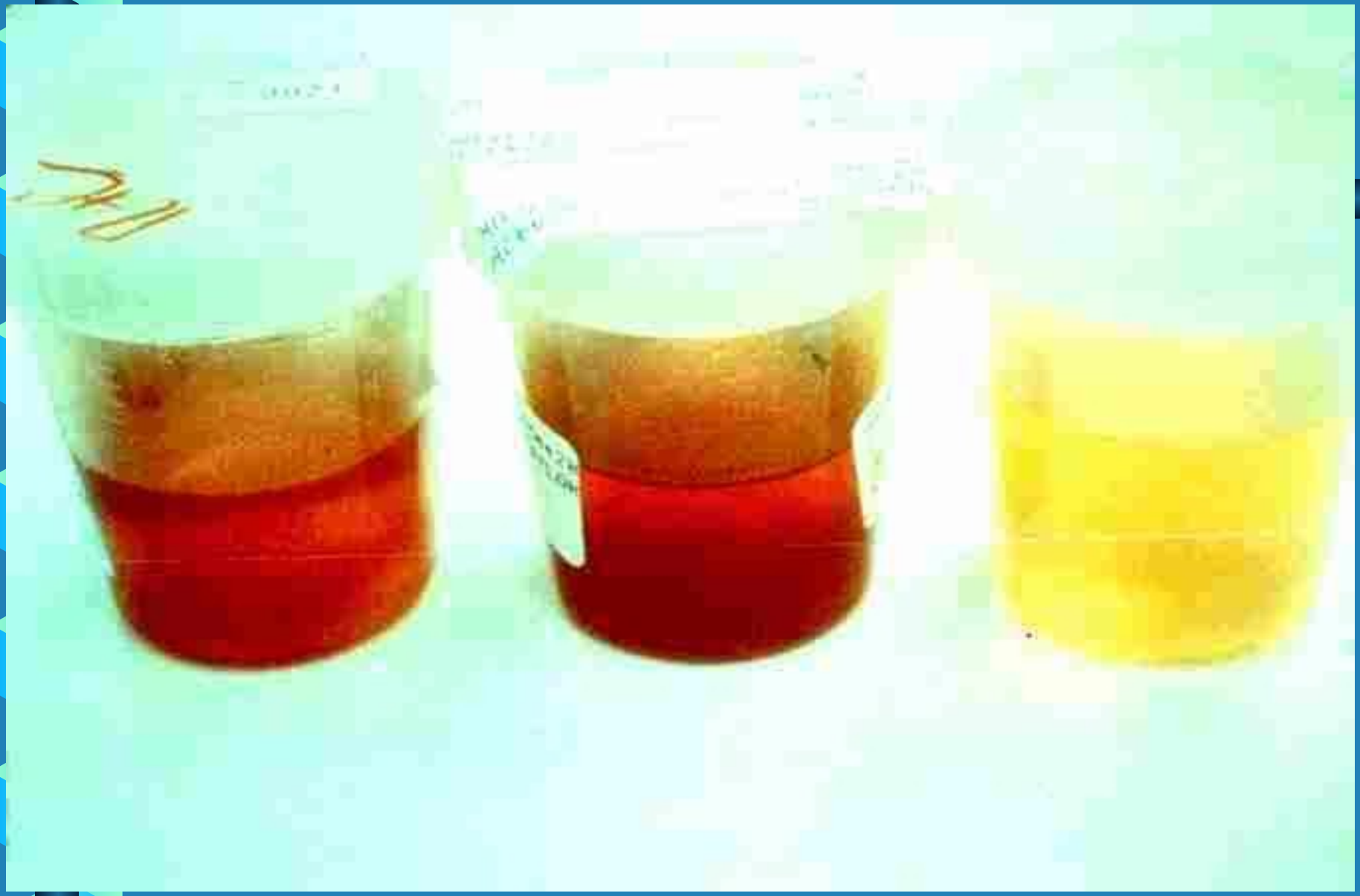


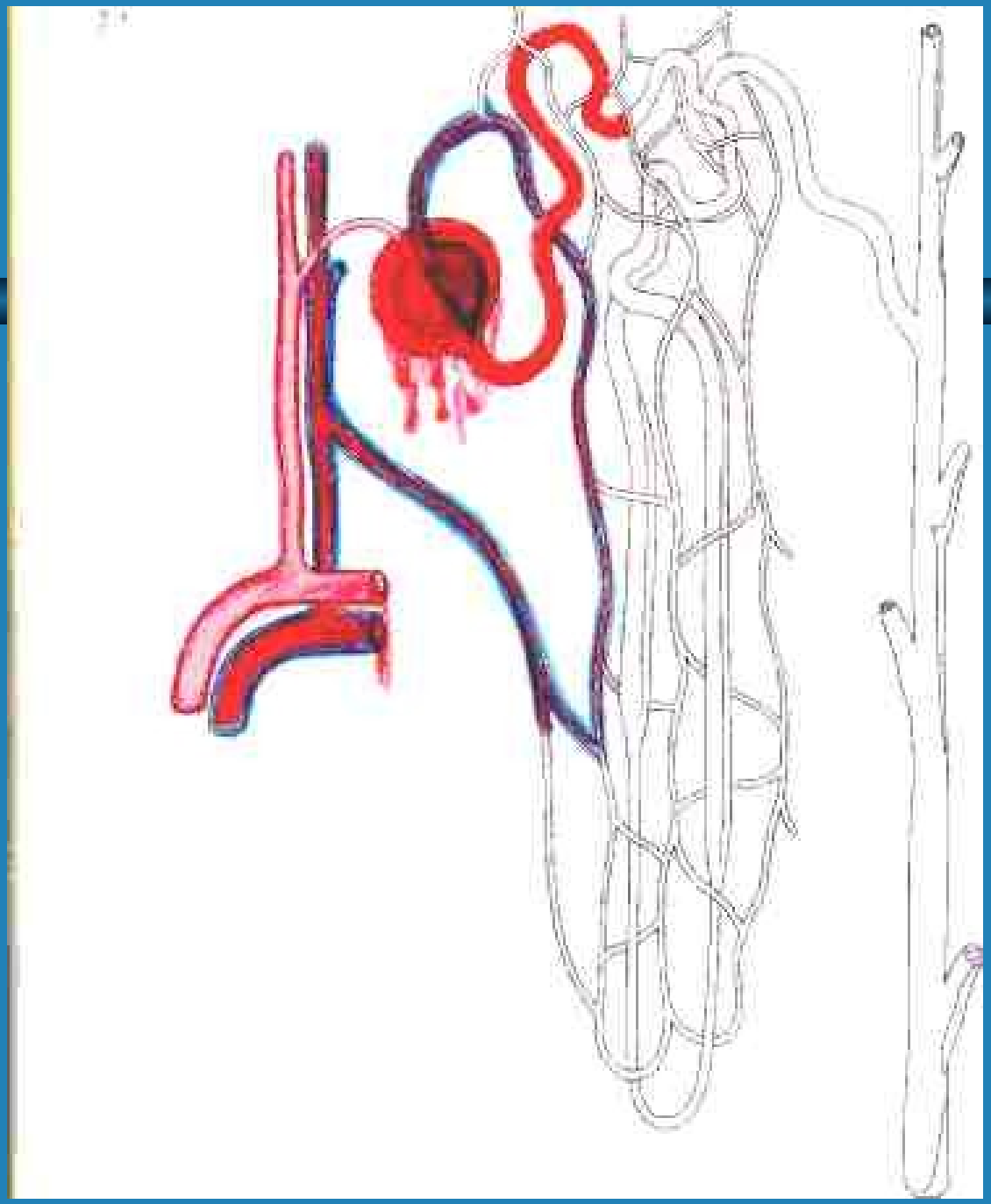


List of Diagnoses from Renal biopsies, WRAMC, 1994-1998

Re		
Final Diagnosis2	Final Diagnosis	Total
amyloidosis	amyloidosis	1
C1q nephropathy	C1q nephropathy	1
chronic sclerosing GN	chronic sclerosing GN	2
CRF	CRF	1
CyA/FK toxicity	CyA/FK toxicity	1
diabetic nephropathy	diabetic nephropathy	8
FSGS	FSGS	24
Hereditary Nephritis	Hereditary Nephritis	1
HIV nephropathy	HIV nephropathy	2
hypertensive nephrosclerosis	hypertensive nephrosclerosis	2
IgA nephropathy	IgA nephropathy	10
IgM nephropathy	IgM nephropathy	6
immune complex GN	immune complex GN	1
Inadequate	Inadequate	1
inadequate	inadequate	4
interstitial nephritis	interstitial nephritis	4
membranous - idiopathic	membranous - idiopathic	6
membranous - secondary	membranous - secondary	3
mesangial GN	mesangial GN	3
minimal change dz	minimal change dz	4
multiple myeloma	multiple myeloma	4
N/A	N/A	15
other (enter comment)	other (enter comment)	2
PAN - microscopic	PAN - microscopic	1
Rejection		12
SLE		10
Grand Total		129

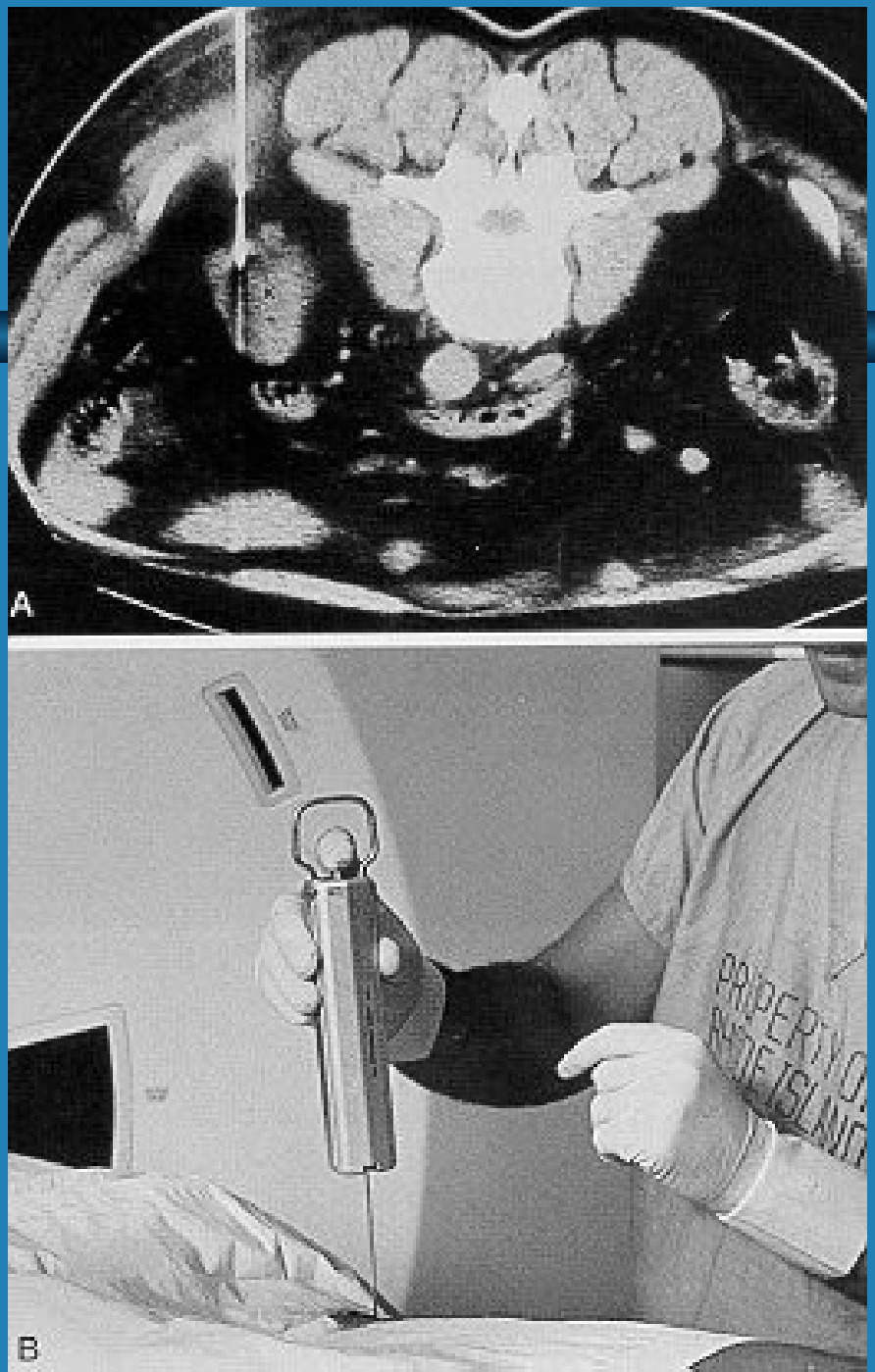

Hematoma
Kidney Capsule





Current Practice

- CT-Guided biopsy also has a long track record. It does not allow direct visualization, but can allow successful percutaneous biopsy when kidney position does not support ultrasound guided biopsy (ie, if the kidneys do not fall below the ribs with inspiration).


A
B

Current Practice--comparison of manual vs. automated biopsies

- Only one study has compared manual vs. “automated” renal biopsies in a prospective fashion (1).

Current Practice--comparison of manual vs. automated biopsies

- Population: 166 patients who underwent percutaneous renal biopsy at Suwon, Korea (Ajou University Medical Center) were randomized in a prospective trial from June 1994 to February 1997.

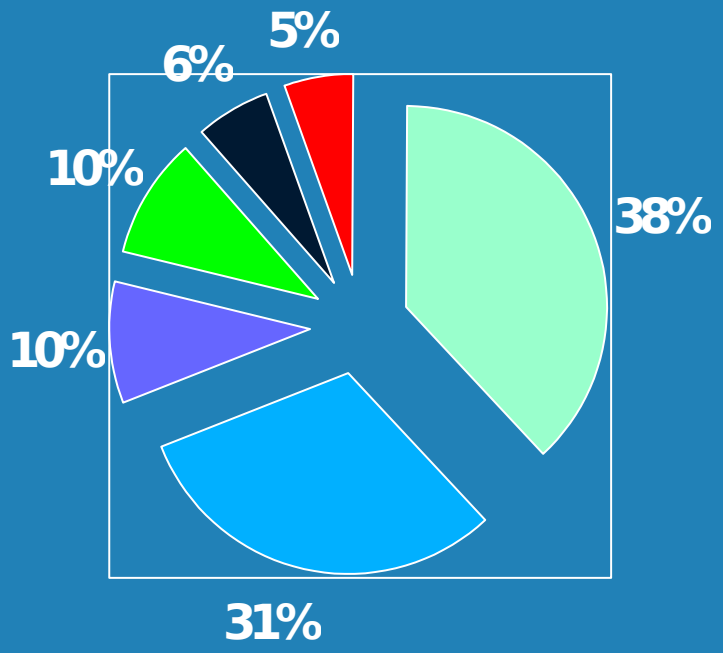
Current Practice--comparison of manual vs. automated biopsies

- Groups:
  - 67 underwent manual Tru-Cut 14 G needle biopsy under ultrasound localization, but not real-time guidance.
  - 99 underwent biopsy with 18 G automated gun (Pro-Mag 2.2 biopsy system) under real-time guidance.
- All groups had left kidney biopsied

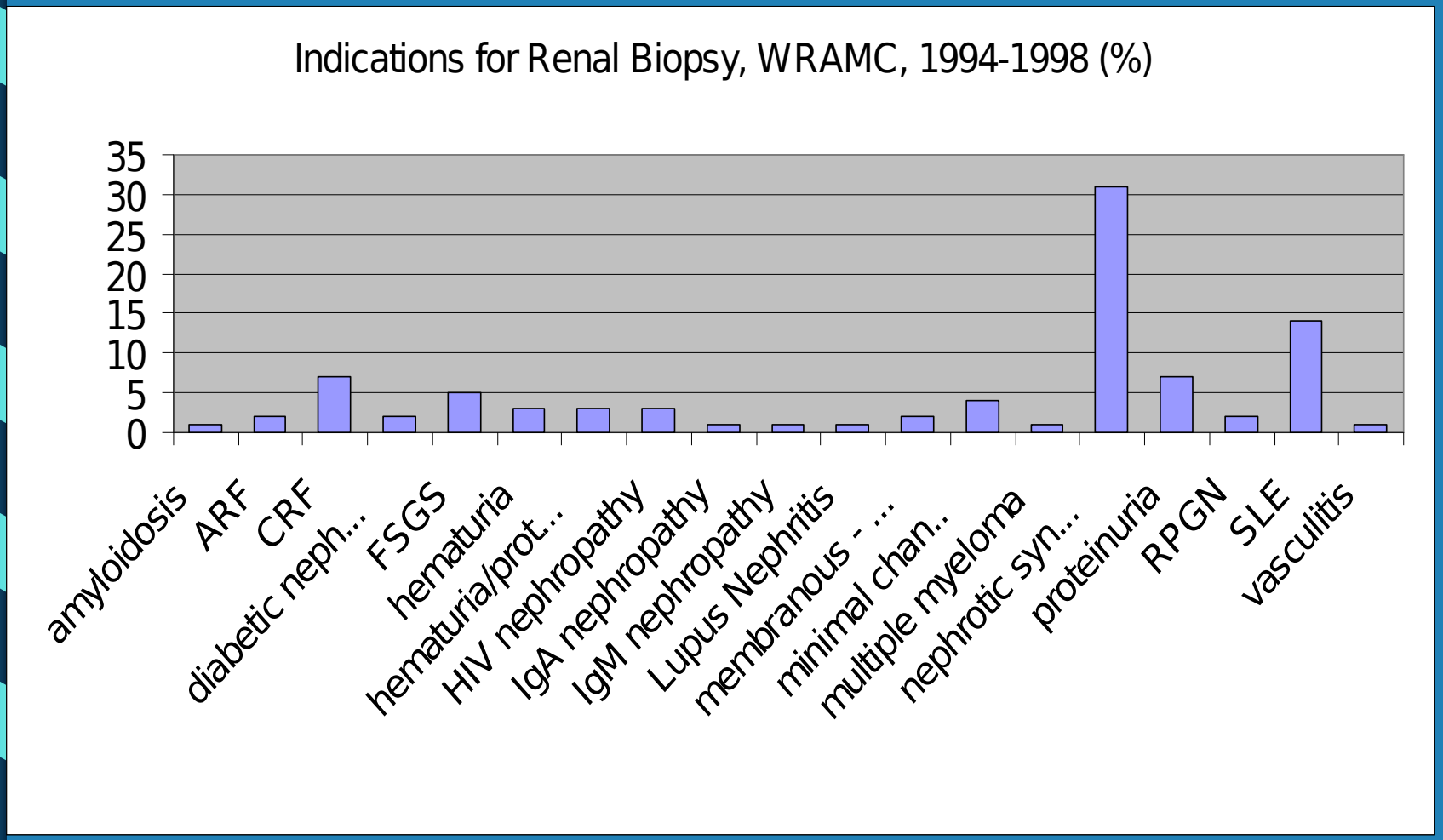
Current Practice--comparison of manual vs. automated biopsies

- Tru-Cut biopsies performed by one nephrologist
- Automated biopsies performed by several physicians including trainees under supervision.
- At least two cores obtained.
- Adequacy defined as at least five glomeruli (analyzed immediately by pathology, technique not stated).

Current Practice--comparison of manual vs. automated biopsies



Current Practice: WRAMC

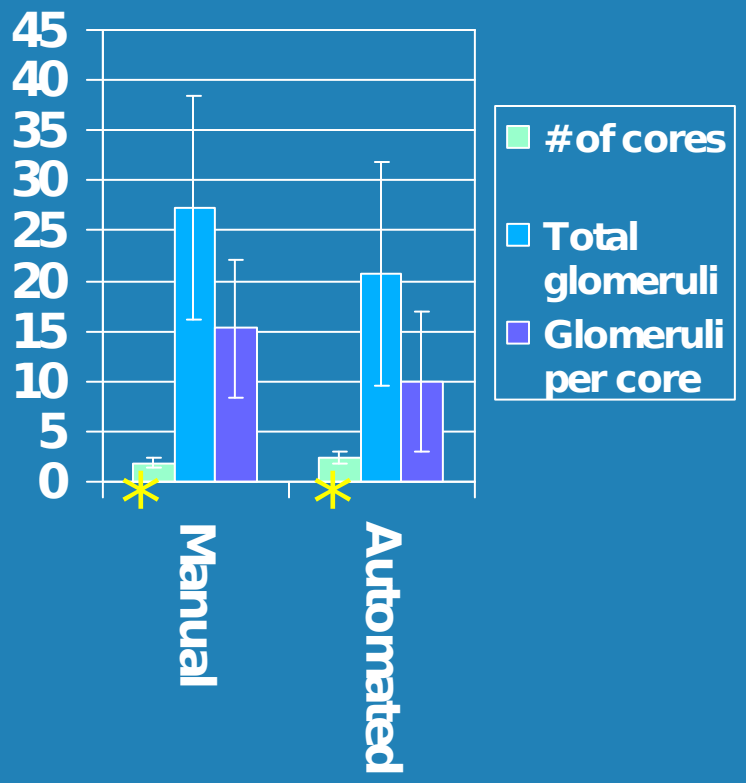


Current Practice--comparison of manual vs. automated biopsies

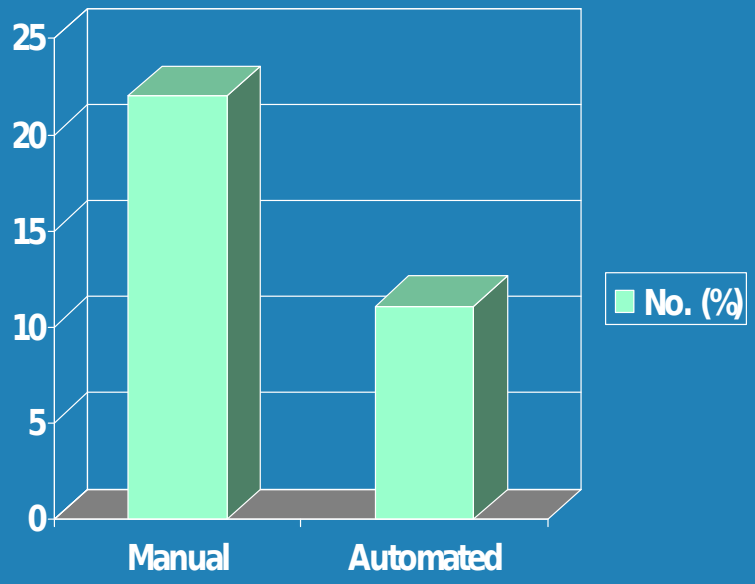
- Groups were comparable in gender ratio (1.15:1 vs 1.23:1 males to females), age (35 yrs), coagulation and hematocrits, and blood pressures (which were 127/81 and 126/80 respectively--use of antihypertensive medications not mentioned).

Current Practice--comparison of manual vs. automated biopsies

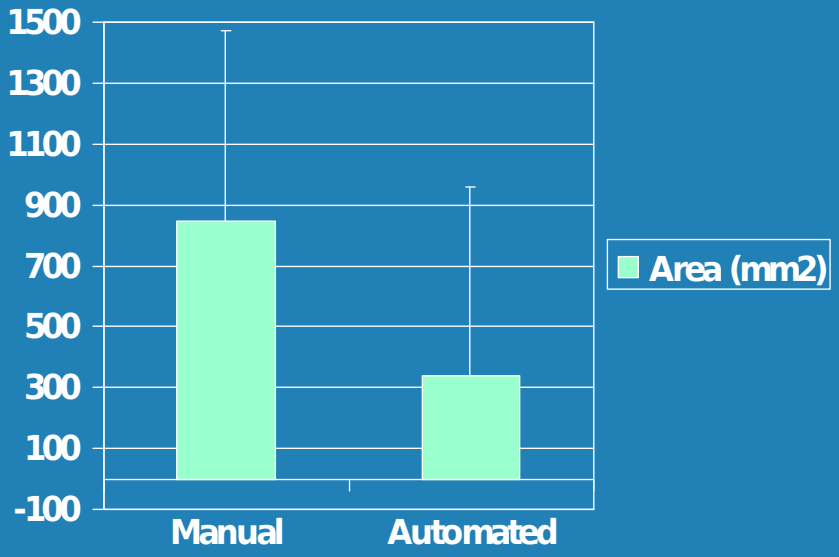
- Differences between the two techniques.
- *=p<0.001 for the number of cores (1.88 for manual to 2.37 for automated)
- Significantly greater total glomeruli (p 0.017) and glomeruli per core (p 0.026) for manual biopsy



Current Practice--comparison of manual vs. automated biopsies



No. of perirenal hematomas (%)



Area of perirenal hematomas (mm2)

Current Practice--comparison of manual vs. automated biopsies

- Hematocrit (but not hemoglobin) values decreased significantly after the biopsy in the manual group (34.9 to 34.0, P=0.03) while no significant change was seen in the automated group (35.1 to 34.7). It is doubtful these differences would be clinically important.

Current Practice--comparison of manual vs. automated biopsies

- One patient in each group was transfused PRBC's, in each case BEFORE the biopsy, because hematocrits were already low. There were no deaths or other severe complications.

Current Practice--comparison of manual vs. automated biopsies

- Many retrospective studies have demonstrated lack of significant differences in complication rates and tissue adequacy between manual and automated techniques.
- A review summarizes most of the major reports (including pediatric and transplant) listed 3 AVF's and 1 death in 4834 reported biopsy series (1)

Current Practice--does size matter?

- Only one study has compared the effect of two different needle gauges when biopsy technique was otherwise held constant (in this case, CT guided biopsy), although in a retrospective fashion (1).

Current Practice--does size matter?

- Bard Biopty guns were used
- Major hemorrhagic complications occurred in 2.7% of the 18g group and 3.4% of the 14 g group (insig).
- Mean intact glomeruli per specimen were 10.7 with 18g and 13.7 with 14g (insig).
- Tissue recovery was 96% and 99% respectively.

Current Practice: inpatient or outpatient?

- Renal Biopsy as an outpatient procedure (1): Prospective study of 350 patients in Australia “offered the choice” between inpatient (strict bedrest for 24 hours) and outpatient management (allowed to leave after 8 hours) of renal biopsy between 1992 and 1994.
- Median age was 38.5 yrs
- Indications for biopsy not listed

Current Practice: inpatient or outpatient?

- Preponderance of females because of association with obstetrics hospital.
- “High risk” patients were excluded: Scr >2.7 mg/dl, or with renal transplant, or already in hospital.

Current Practice: inpatient or outpatient?

- Vim-Silverman needle was used with imaging by fluoroscopy or ultrasound, no real-time guidance.
- Complications were 2/118 (1.7%) for the outpatient group vs. 3/232 (1.3%) for the inpatient group.
- Longer term follow-up was not mentioned.

Current Practice: inpatient or outpatient?

- Power was 91% to detect a 10% (reasonable clinical difference) between groups, indicating adequate sample size.
- No patients required transfusions and there were no deaths.
- They attributed their low rate of complications to aiming for the lateral border of the mid-pole of the kidney.

Current practice: how long to observe?

- Mounting pressure by managed care to not only switch to outpatient management but to decrease period of observation to 6-8 hours (ie, a business day or one nurse's shift).
- Is it safe?

Current practice: how long to observe?

- 394 patients underwent 14 G Trucut (225 patients) or later 14 G automated needle biopsy between 1983 and 1995 (1).
- Imaging done by real time ultrasound
- Average age was mid 40’s. Males were the minority (<40%).
- Scr was 2.9 mg/dl for those with complications and 2.3 for those without.

Current practice: how long to observe?

- Total complication rate was 13%.
- 6.6% for minor complications (gross hematuria and perirenal hematomas that resolved).
- 6.6% for major complications (transfusion req bleed (22), invasive procedure needed (3), infectious complication).
- No deaths or nephrectomies

Current practice: how long to observe?

- Major complications identified in 46% of patients at <4 hrs, 79% at <8 hrs, and 100% at 12 hours.
- Thus, 20% of complications would have been missed by release at 8 hours.
- Authors still recommend 23 hour observation.

Current practice: how long to observe?

	Hours Post Biopsy				
	<4	5-8	9-12	13-24	>24
Minor complication (n)	12	3	3	1	1
Major complication (n)	11	8	5	0	0

Current practice: how long to observe: Pediatrics?

- A study of 177 percutaneous renal biopsies in pediatric patients reported a 3.4% major complication rate and 14.1% minor complication rate. (1)
- All patients with major complications were diagnosed within 11 hours.

Contraindications to percutaneous biopsy (or, who IS at high risk?)

- Bleeding diathesis
  - Can usually be controlled prior to and for a few days following the biopsy
- Have previously recommended open biopsy with direct visualization if not controllable. Open biopsy has been done with mild sedation and local anesthetic (1).

Contraindications

- The risk of general anesthesia varies with ASA class. For ASA 2 (mild to moderate systemic disturbances, such as essential hypertension, mild diabetes or anemia) the death rate is 3/1000 (1).
- For Class 3 death risk is 1.8%, and 7.8% for Class 4.

Contraindications

- In the opinion of some (such as Dr. Modaio, in Renal Biopsy, Kidney Int, 38:529-543, 1990) the solitary kidney was thus a relative contraindication to percutaneous renal biopsy.
- The risks of anesthesia from an open procedure might be greater than the risk of nephrectomy from a closed procedure.
- The option of an open procedure under local anesthesia was not mentioned.
- Transvenous biopsy and other techniques were only beginning then.

Contraindications

- Unable to cooperate (in adults, these patients would not be biopsied unless judged incompetent with a consenting guardian. In children, sedation is generally used.)
- Single kidney
  - Risk of nephrectomy following renal biopsy reported at 5/8081 (1/1616) at the first ASN meeting (1968). Risk of death 1/2000 to 1/5000 (see references below)

Contraindications

- The other important contraindication is patients with end-stage or near end-stage renal disease with small kidneys. Significant complications were reported (5/29, 17%) in a study by Kropp et al (1). In these patients, Modaio still recommended open biopsy, although the need to biopsy such patients at all was questioned.

Conclusions

- Real-time ultrasound guidance has become increasingly accepted as standard practice for kidney biopsies in medical diseases of the kidney, at least in Army Nephrology
- Although evidence demonstrating improved outcomes is scarce, ease of obtaining quality tissue is superior and skills can be quickly mastered.

Conclusions

- This procedure has shifted from an inpatient to an outpatient procedure in the last decade
- Current evidence does not support shortening the duration of observation to less than 23 hours

Conclusions

- Important contraindications to the percutaneous approach include uncorrectable bleeding diathesis, inability to cooperate or understand the procedure, ESRD with small kidneys. A solitary kidney remains controversial.
- Renal biopsy in these high risk patients is covered in a separate lecture.